

We claim:

1.

1 A fuel pump module, comprising:
2 a reservoir;
3 a high pressure fuel pump having an inlet communicating with the
4 reservoir and having an outlet;
5 a nozzle having an outlet in fluid communication with the outlet of the
6 high pressure fuel pump for fuel flow therebetween; and
7 at least one restrictor plate received between the outlet of the fuel
8 pump and the outlet of the nozzle, the restrictor plate having an orifice restricting the
9 flow of fuel flowing to the nozzle.

2.

1 The fuel pump module of claim 1 wherein the reservoir has an inlet
2 and the outlet of the nozzle is generally adjacent the inlet.

3.

1 The fuel pump module of claim 1 wherein the reservoir has an inlet
2 and further comprising a first venturi axially spaced from the nozzle generally
3 between the nozzle and the inlet of the reservoir, the first venturi having an inlet in
4 fluid communication with the outlet of the nozzle to receive fuel discharged from the

5 outlet of the nozzle, and having an outlet through which fuel is discharged generally
6 toward the inlet of the reservoir.

4.

1 The fuel pump module of claim 3 further comprising a second venturi
2 having an inlet in fluid communication with the outlet of the first venturi to receive
3 fuel discharged from the first venturi, and having an outlet through which fuel is
4 discharged generally toward the inlet of the reservoir.

5.

1 The fuel pump module of claim 4 wherein the first venturi and the
2 second venturi are constructed as a single piece of material.

6.

1 The fuel pump module of claim 1 wherein a pair of restrictor plates
2 axially spaced from one another are received between the outlet of the high pressure
3 fuel pump and the outlet of the nozzle.

7.

1 The fuel pump module of claim 1 further comprising a return fuel line
2 extending generally between the outlet of the nozzle and the reservoir.

8.

1 The fuel pump module of claim 7 wherein the reservoir has an inlet
2 and the return fuel line extends generally adjacent the inlet of the reservoir.

9.

1 A fuel transfer arrangement for transferring fuel from outside a
2 reservoir of a fuel system into the reservoir, comprising:

3 a high pressure fuel pump having an outlet of high pressure fuel,
4 a nozzle receiving a first volume of fuel under pressure from the outlet
5 and dispensing a first stream of fuel from the nozzle;

6 a first venturi operably connected to the nozzle downstream from the
7 nozzle and the first venturi providing entrainment of fuel adjacent the first venturi
8 into the first stream of fuel to provide a second stream of fuel having a second
9 volume, and discharged from the first venturi, the second volume being greater than
10 the first volume; and

11 a second venturi axially spaced downstream from the first venturi
12 providing entrainment of fuel adjacent the second venturi into the second stream of
13 fuel exiting the first venturi to provide a third stream of fuel having a third volume
14 and discharged from the second venturi, the third volume being greater than the
15 second volume and the third stream being delivered to the reservoir.

10.

1 The fuel transfer arrangement of claim 9 wherein the first venturi and
2 the second venturi are operably connected to one another.

11.

1 The fuel transfer arrangement of claim 10 wherein the first venturi and
2 the second venturi are constructed as a single piece of material.

12.

1 The fuel transfer arrangement of claim 9 further comprising at least
2 one restrictor plate having an orifice upstream from said nozzle.

13.

1 The fuel transfer arrangement of claim 12 wherein a pair of restrictor
2 plates axially spaced from one another are arranged upstream of said nozzle.

14.

1 The fuel transfer arrangement of claim 9 further comprising a fuel line
2 in fluid communication with the second venturi and communicating fuel exiting the
3 second venturi generally toward the reservoir.

15.

1 A fuel transfer arrangement for transferring fuel from one portion of a
2 fuel tank, comprising:

3 a source of pressurized fuel;

4 a nozzle disposed in one portion of the fuel tank, having an inlet in
5 communication with the source of pressurized fuel to receive pressurized fuel, and an
6 outlet through which fuel is discharged;

7 a first venturi having an inlet in communication with said one portion
8 of the fuel tank and with the outlet of the nozzle to receive fuel discharged from the
9 nozzle, and an outlet through which fuel is discharged from the first venturi, the flow
10 of fuel from the nozzle to the first venturi causing fuel to move from said one portion
11 of the fuel tank into the inlet of the first venturi; and

12 a second venturi having an inlet in communication with said one
13 portion of the fuel tank and with the outlet of the first venturi to receive fuel
14 discharged from the first venturi, and an outlet in communication with said another
15 portion of one of the fuel tank and a reservoir to move fuel from said second venturi
16 to said one of another portion of the fuel tank and the reservoir, the flow of fuel
17 between the first venturi and second venturi causing fuel to move from said one
18 portion of the fuel tank into the inlet of the second venturi.

16.

1 The fuel transfer arrangement of claim 15 wherein said one portion is a
2 fuel tank and said another portion is a reservoir in the fuel tank.

17.

1 The fuel transfer arrangement of claim 15 wherein the fuel discharged
2 from the outlet of the nozzle flows at a first flow rate and the fuel discharged from the
3 outlet of the first venturi flows at a second flow rate, the second flow rate being
4 greater than the first flow rate.

18.

1 The fuel transfer arrangement of claim 17 wherein the fuel discharged
2 from the outlet of the second venturi flows at a third flow rate, the third flow rate
3 being greater than the second flow rate.

19.

1 The fuel transfer arrangement of claim 15 wherein the inlets and
2 outlets of the nozzle, first venturi and second venturi are co-axially aligned.

20.

1 The fuel transfer arrangement of claim 19 wherein the outlet of the
2 nozzle and the inlet of the first venturi are axially spaced from one another and the
3 outlet of the first venturi and the inlet of the second venturi are axially spaced from
4 one another.

21.

1 The fuel transfer arrangement of claim 15 wherein the source of
2 pressurized fuel is a high pressure fuel pump having an outlet through which fuel is
3 discharged under pressure and the inlet of the nozzle receives a portion of the fuel
4 discharged from the high pressure fuel pump.

22.

1 The fuel transfer arrangement of claim 15 further comprising at least
2 one restrictor plate having an orifice restricting the flow of pressurized fuel between
3 said source and the nozzle.

23.

1 The fuel transfer arrangement of claim 22 wherein the pressurized fuel
2 between said source and the restrictor plate has one pressure and the pressurized fuel
3 between the restrictor plate and the nozzle has another pressure, said one pressure
4 being greater than said another pressure.

24.

1 The fuel transfer arrangement of claim 22 wherein the restrictor plate
2 is axially spaced from the inlet of the nozzle.

25.

1 The fuel transfer arrangement of claim 22 wherein a pair of restrictor
2 plates restrict the flow of pressurized fuel between said source and the nozzle.

26.

1 The fuel transfer arrangement of claim 25 wherein the pair of restrictor
2 plates are axially spaced from one another and from the nozzle.

27.

1 The fuel transfer arrangement of claim 25 wherein the pressurized fuel
2 between said source and one of the restrictor plates has a first pressure and the
3 pressurized fuel between the restrictor plates has a second pressure and the
4 pressurized fuel between another of the restrictor plates and the nozzle has a third
5 pressure, the first pressure being greater than the second pressure and the second
6 pressure being greater than the third pressure.

28.

1 The fuel transfer arrangement of claim 25 wherein the nozzle has a
2 passage with a diameter defining the inlet and the outlet of the nozzle and the orifices
3 have diameters, the diameter of the passage in the nozzle being equal to or less than
4 the diameters of the orifices.

29.

1 The fuel transfer arrangement of claim 22 wherein the nozzle has a
2 passage with a diameter defining the inlet and the outlet of the nozzle and the orifice
3 has a diameter, the diameter of the passage in the nozzle being greater than, equal to
4 or less than the diameter of the orifice.

30.

1 The fuel transfer arrangement of claim 15 wherein the first venturi and
2 the second venturi are formed as a single piece of material.

31.

1 The fuel transfer arrangement of claim 30 wherein the first venturi and
2 the second venturi are injection molded.

32.

1 A fuel transfer arrangement for transferring fuel from one portion of a
2 fuel tank to another portion of a fuel tank spaced from said one portion, comprising:
3 a source of pressurized fuel;
4 a nozzle disposed in one portion of the fuel tank, having an inlet in
5 communication with the source of pressurized fuel to receive pressurized fuel, and an
6 outlet through which fuel is discharged; and
7 at least one restrictor plate having an orifice communicating with the
8 source of pressurized fuel between said source and the nozzle.

33.

1 The fuel transfer arrangement of claim 32 wherein the pressurized fuel
2 between said source and the orifice has one pressure and the pressurized fuel between
3 the orifice and the nozzle has another pressure, said one pressure being greater than
4 said another pressure.

34.

1 The fuel transfer arrangement of claim 32 wherein the orifice is axially
2 spaced upstream from the inlet of the nozzle.

35.

1 The fuel transfer arrangement of claim 32 wherein a pair of orifices
2 communicate with the source of high pressure fuel between said source and the
3 nozzle.

36.

1 The fuel transfer arrangement of claim 35 wherein the pair of orifices
2 are axially spaced from one another.

37.

1 The fuel transfer arrangement of claim 35 wherein the pressurized fuel
2 between said source and one of the orifices has a first pressure and the pressurized
3 fuel between the orifices has a second pressure and the pressurized fuel between
4 another of the orifices and the nozzle has a third pressure, the first pressure being
5 greater than the second pressure and the second pressure being greater than the third
6 pressure.

38.

1 The fuel transfer arrangement of claim 35 wherein the nozzle has a
2 passage with a diameter defining the inlet and the outlet of the nozzle and the orifices
3 have diameters, the diameter of the passage in the nozzle being equal to or less than
4 the diameters of the orifices.

39.

1 The fuel transfer arrangement of claim 32 wherein the nozzle has a
2 passage with a diameter defining the inlet and the outlet of the nozzle and the orifice
3 has a diameter, the diameter of the passage in the nozzle being equal to or less than
4 the diameter of the orifice.